

EARTHWORMS FROM HAKODATE, HOKKAIDÔ

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ONE PLATE

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Hakodate is a harbour well-known as the type locality of the earthworms *Allolobophora japonica* and *Pheretima hilgendorfi*. But no further species is known from there. Recently, Mr. Tadashi Tamura of the Hakodate College of Fisheries sent me, at my request, a number of worms collected in the beginning of September 1937 in Hakodate and its vicinity. This collection includes fourteen species of which *Pheretima hilgendorfi*, *Allolobophora japonica*, and *Bimastus tenuis* are the most predominant. It is especially noteworthy that *Ph. phaselus kamitai* and *Ph. Marenzelleri* are represented; the former species was recently recorded from Korea, and the latter species was reported about thirty years ago from Yokohama. The discovery of *B. tenuis* is a new record from Japan, although it is a semi-cosmopolitan worm. An endemic species, *Ph. yezoensis*, n. sp. is found, and so Hakodate is included within the *Pheretima*-region. No *Drawidian* worm is represented.

Before going further, I wish to express my hearty thanks to Mr. Tadashi Tamura for his kindness in supplying me with the present material. It is also my pleasure to record my best thanks to Prof. Harujirô Kobayashi and to Prof. Tamezô Mori, of the Keijô Imperial University, for their encouragement to my study. I am also indebted to Mr. Shinryô Ohfuchi of the Saitô Hô-on Kai Museum for his kind informations.

1. *Pheretima agrestis* (Goto et Hatai) 1899

1938. *Pheretima agrestis*, Kobayashi, Sci. Rep. Tôhoku Imp. Univ., Biol., in press.

2. *Pheretima divergens* (Michaelsen) 1892

1937. *Pheretima divergens*, Ohfuchi, Saitô Hô-on Kai Mus., Res. Bull., No. 12, pp. 67-108.

Japanese garden in Hakodate, one clitellate and one aclitellate

specimens. Cultivated field in Hakodate, one clitellate specimen. Nanaé-hama-mura, one clitellate specimen.

Description: External characteristics: Prostomium, epilobous ca. $1/2$ – $2/3$. First dorsal pore in $12/13$, distinct and functional. Setae moderate in size; those on about III–IX slightly enlarged; ventral ones more widely spaced than the dorsal. Both mid-dorsal and mid-ventral breaks found but very slight. Spermathecal setae 11–13/V, 11–14/VI, 12–15/VII, 13–15/VIII, male pore setae 8–10. Male pores entirely absent in two specimens, but present in the remaining two. Male porophore circular and slightly elevated, similar to or a little larger than the genital papillae; pores ventrally about $1/3$ of the circumference apart. Genital papillae near this region found in all the specimens; considerably variable, on XVII–XIX, 4–10 in number, and both presetally and postsetally. Spermathecal pores, four pairs in $5/6$ – $8/9$, ventrally about $1/3$ of the circumference apart; each pore anteriorly with a spermathecal papilla. Genital papillae found near this region in three specimens; considerably variable, on VII–IX, 1–7 in number, and both presetally and postetally.

Internal anatomy: Septa moderately well-developed; $8/9$ ventrally traceable, $9/10$ absent. Intestine in XVI. Hearts in X quite vestigial in size or not found. Lymph glands begin to appear in $17/18$ and are very small, but those behind caecal segment become much larger and are club-shaped. Testis sacs, two pairs ventrally in X and XI, fairly large; anterior pair of a massive V-shape, projecting into X; posterior pair of a rectangular sac with massive and rounded wings. Seminal vesicles, two pairs in XI and XII, oval and rather small; each with a relatively very large (sometimes larger than the main portion), ovoidal, distinctly constricted dorsal lobe which is smooth, but slightly darkened on surface. Dorsal surface of the dorsal lobe usually attached to the posterior face of the septum. Pseudovesicles, two pairs, large. Prostate gland moderate in size, in XVII–XIX, lobular but rather smooth on surface; duct thin but moderate in length, looped in a C-shape. When male pores are externally invisible, prostates are entirely absent, and sperm-ducts terminate blindly (usually behind XVIII as in *Ph. hilgendorfi*). Spermathecae very small, in VI–IX. In every case, the diverticulum is absent, but a knob-like swelling is found in one case.

Remarks: The present species was studied in detail by Ohfuchi recently ('37). But he did not give any complete description; the setal

arrangement, spermathecal setae, male and spermathecal aspects, vascular system, and structure of the anterior male organs were left undescribed, or given only abbreviated statements. The present species is very close, especially in the internal characters, to both *Ph. oyamai* and *Ph. Marenzelleri*. But, as they are clearly different externally, it is easy to separate them even when they are mingled.

3. *Pheretima hilgendorfi* (Michaelsen) 1892

1938. *Pheretima hilgendorfi*, Kobayashi, Sci. Rep. Tôhoku Imp. Univ., Biol., in press.

4. *Pheretima Marenzelleri* Cognetti 1906

1906. *Pheretima Marenzelleri*, Cognetti, R. Acad. Sci. Torino, Vol. XLI, pp. 6-7, figs. 5-6. (Yokohama, Japan).

Under fallen leaves in a field of the Chinese bell-flowers, about 8 km. from Hakodate, six clitellate specimens. Under a heap of horse manure in Hakodate, one clitellate specimen. Nanaé-hamamura, one clitellate specimen.

Description: External characteristics: Only one specimen is complete; length 160 mm, greatest diameter 7 mm, number of segments 130. Preclitellar region somewhat cylindrical, slightly thinner than the post-clitellar, and weakly constricted in front of the clitellum. Colour in formalin, uniformly with pearly iridescence, dorsally greyish deep purple, ventrally yellowish grey, clitellum light chocolate; parietal wall also with pearly iridescence. Prostomium, epilobous ca. 1/2; peristomium rather thin and not so muscled as in the other species. First dorsal pore in 12/13, distinct and functional. Clitellum entire, in XIV-XVI, without setae.

Setae moderate in size; ventral ones on about III-IX may be very slightly enlarged. Both mid-dorsal and -ventral breaks found, but very slight. Setal number as follows: 24-26/III, 38-43/VII, 45-49/XIII, 45-46/XVII, 50-54/XXIV, 47-51/middle portion of the body, spermathecal setae 10-11/V, 12/VI, 12-13/VII, 13-14/VIII, 13-15/IX, male pore setae 8-10.

Male porophore (Pl. 18, fig. 1, a), oval and moderate in size, occupying about middle 1/3 of the antero-posterior length of XVIII, and with a few circumferential furrows forming as a whole an oval area which is slightly elevated, glandulated, and whitish; pores ventrally about 6 mm, or about 1/3 of the circumference, apart.

Female pore single, midventrally on XIV, in a small, longitudinally oval and whitish area.

Spermathecal pores, four pairs in 5/6-8/9, ventrally about 2/7 of the circumference apart; each pore anteriorly with a spermathecal papilla. Genital papillae absent on both pre- and post-clitellar regions in all specimens.

Internal anatomy: Septa moderately well-developed; 8/9 present but delicate, 9/10 absent. Intestine in XVI; caeca in XXVII, simple and finger-shaped, extending anteriorly to about XXIV, each ventrally with a few indentations. Hearts in X vestigial or missing. Lymph glands begin to appear in 17/18 and are very small, but those behind caecal segment become very much larger and are club-shaped or sac-like.

Anterior male organs are similar in shape to those of *Ph. divergens*.

Pseudovesicles, two pairs, large; usually the posterior pair smaller than the anterior.

Prostate gland poorly developed, consisting of only one or two main lobes and rather smooth on surface, usually confined to only XVIII, but in XVII-XIX in one specimen; duct short but moderate in thickness, looped in an S- or C-shape, placing its curved portion near the ventral nerve cord.

Spermathecae (fig. 1, b) very small or rather vestigial in size; the first three pairs in VI-VIII and the last pair also in VIII, but just in front of the membranous septum 8/9. Diverticulum always absent. Ampulla heart-shaped but dorsoventrally flattened; duct thin, subequal in length to the ampulla. In one specimen, the last pair of spermathecae tubular, and distally with a very small swelling as an ampulla (fig. 1, c); those in VIII only of a short club-shaped duct; those in VII and VI absent. Vestigial accessory glands are found corresponding to the spermathecal papillae.

Remarks: Since the publication of Cognetti's original paper no further statements on this species have been published*. Externally the present species is close to *Ph. carnosa*, and internally to both *Ph. divergens* and *Ph. oyamai* as already stated in the remarks about the former species.

* Recently Mr. S. Ohfuchi informed me that, it became clear after a careful examination that his *Ph. Marenzelleri* ('36, Zool. Mag., Vol. 48, No. 4) differs in several characteristics from the Cognetti's description.

5. *Pheretima oyamai* Ohfuchi 1937

1937. *Pheretima oyamai*, Ohfuchi, Saitô Hô-on Kai Mus. Res. Bull., No. 12, pp. 62-66, fig. 10, Pl. 1, 3. (Morioka, Iwate Prefecture; Ôdate, Akita Prefecture).

Cultivated field in Hakodate, 15 clitellate specimens. Nanaé-hamamura, 8 clitellate and 2 aclitellate specimens. Japanese garden in Hakodate, one aclitellate specimen.

Description: External characteristics: Only two specimens are complete; length 162 mm and 185 mm (about 230 mm in an incomplete but large specimen), greatest diameter up to 8 mm; number of segments 126 and 130. Colour in formalin, dorsally purplish brown and concentrated anteriorly, and on the postclitellar segments the colouration of the intersegmental furrows deeper than the rest, and extending into ventro-lateral surfaces which are similarly pale as in the ventral. Thus, the worm appears faintly banded on lateral surfaces (but, not so distinctly as in *Ph. vittata*). Clitellum fleshy to purplish brown; Prostomium, epilobous ca. 1/4-1/2. First dorsal pore in 12/13, distinct and functional. Setae moderate in size; usually those on about III-IX slightly enlarged; ventral ones slightly more widely spaced than the dorsal, but no marked difference in size found between them; both mid-ventral and mid-dorsal breaks found but slight. Setal number as follows: 24-25/III, 37-39/VII, 44-47/X, 47-49/XIII, 49-50/XVII, 47-48/XXIV, 53-57/middle portion of the body, spermathecal setae 10-11/V, 10-12/VI, 11-13/VII, 11-13/VIII, male pore setae 7-10 (usually 8).

Male pores usually present ventro-laterally on the setal line of XVIII, but sometimes absent. Male pore aspects slightly variable. Ia (fig. 2, a), pores sometimes absent on one side or on both; setal zone depressed in the supposed male pore-point (depression parallel to the general surface of the body), but any kind of openings not recognizable even under the microscope. Ib (fig. 2, b), in a similar condition to Ia, a transversely wrinkle-like slit found in the depression continues internally to the prostatic duct. IIa (fig. 2, c), in the setal line a small and circular porophore (with a minute opening) with one or two circumferential furrows is found, forming as a whole a somewhat rhombic patch. The patch is very slightly elevated, glandulated, and occupies the middle 1/3 of the antero-posterior length of XVIII. Sometimes, a genital papilla which is frequently presetal and immediately antero-medial to the porophore, may be also enclosed within the patch. IIb, similar to IIa, with a distinct and transverse slit-like opening on the surface of the porophore; IIc situated in the centre of a slightly depressed and darkened porophore. Excep-

tionally genital papillae are found either on XVII or XIX on the same line.

Spermathecal pores, four pairs in 5/6-8/9, ventrally slightly less than $1/3$ of the circumference apart; each pore anteriorly with a spermathecal papilla. Genital papillae near this region are found in 16 specimens, similar in shape and in size to those of the male pore regions, considerably variable in occurrence, presetally on VII-IX, a single one—3 pairs in number, close to the spermathecal line.

Internal anatomy: Septa moderately well-developed; 8/9 ventrally traceable, 9/10 absent. Intestine in XVI; caeca in XXVII-XXIV or -XXIII, simple and rather slender. Hearts in X not found. Lymph glands begin to appear in 17/18, and are moderate in size and club-shaped; those behind caecal segment become much larger. Anterior male organs are similar in shape to those of both *Ph. divergens* and *Ph. Marenzelleri*. Pseudovesicles, two pairs, club-shaped; usually the posterior pair very small. Prostates always poorly developed, sometimes glandular portion absent. Gland occupying only one segment, frequently situated in XVII instead of XVIII (duct always in XVIII). Duct short but moderate in thickness, looped in a C- or S-shape. When male pores are externally absent, sperm-ducts terminate blindly as in *Ph. agrestis* in various segment of XV-XIX. Spermathecae very small, and diverticulum absent (fig. 2, d). First three pairs in V-VIII, and the last pair also in VIII, but just in front of the vestigial septum 8/9. Close to the ectal end of the duct, one or two vestigial accessory glands are found, corresponding to each spermathecal papilla.

Remarks: The original description of the present species is rather abbreviated. This is more close to *Ph. Marenzelleri* than to *Ph. grossa* in many respects.

6. *Pheretima phaselus* var. *typica* Hatai 1930

1930. *Pheretima phaselus*, Hatai, Sci. Rep. Tôhoku Imp. Univ., Biol., Vol. V, No. 4, pp. 659-661, fig. 6.

1938. *Pheretima phaselus*, Kobayashi, Sci. Rep. Tôhoku Imp. Univ., Biol., in press.

Cultivated field in Hakodate, 3 clitellate specimens.

Description: Prostomium, epilobous ca. $1/2$. Setae beginning on II, moderate in size; those on about III-IX sometimes may be slightly enlarged; ventral ones slightly more closely set than the dorsal, and nearly equal in size to the latter. Setal number as follows: 32-34/III, 41-46/V, 48-52\VI, 50-56/VII, 58-64/XVII, 60-68/XX, spermathecal setae 13-16/V, 14-16/VI, 14-17/VII, 15-18-VIII, male pore setae 13-14.

Septa well-developed; 8/9 and 9/10 absent. Hearts in X and XI enclosed within the respective annular testis sac. Lymph glands large or moderate in size, lobular, found behind caecal segment caudalwards. The anterior male organs were not described by Hatai in his original paper. Testis sacs annular in X and XI, conspicuously large. Ventrolateral parts of the anterior ring extend anteriorly into about 7/8, and are very voluminous, containing a large amount of sexual products. Posterior ring is also massive, uniformly containing much of the sexual products. Seminal vesicles are large relatively to the body size, and resemble in shape those of *Ph. fibula typica*, i. e. flattened, circular, and with a small but distinctly constricted dorsal lobe which is usually yellowish comparing with the whitish main portion. Dorsal part of the vesicle sometimes may be slightly incised into a few lobules, which are clearly distinguishable from the primary lobe. The anterior pair is always enclosed within the respective testis sac. In one specimen, a seminal vesicle of the left side is found in XIII instead of XII, but it communicates with the posterior testis sac through the ventral part of 12/13. Pseudovesicles moderate in size, one pair behind 12/13.

Remarks: The original description of the present variety is rather abbreviated, and some important characteristics such as the anterior male organs, vascular system, the number of spermathecal setae are not described. Recently ('38), the present variety was reported from Korea by me; but, I was then obliged to postpone its description owing to the absence of well-preserved material. In the same paper I stated that *Ph. kamitai* may be a special form of *Ph. phaselus* if the latter has annular testis sacs as the former. This presumption has been realized in the present examination.

7. *Pheretima phaselus* var. *kamitai* Kobayashi 1934

1938. *Pheretima kamitai*, Kobayashi, Sci. Rep. Tōhoku Imp. Univ., Biol., in press.

A cultivated field in Hakodate, 4 clitellate specimens. A cultivated field of the Chinese bell-flowers, about 8 km. from Hakodate, 4 clitellate specimens.

8. *Pheretima phaselus* var. *tamurai*, n. var.

A Japanese garden in Hakodate, one clitellate specimen.

The present variety is distinguishable from the other two by its characteristic male pore aspects.

Male pores situated ventrolaterally on the setal line of XVIII; each pore on an L-shaped patch which is large, moderately elevated and

distinctly outlined (fig. 3). On its surface an L-shaped, shallow and narrow groove is found along the nearly whole length. A male pore without any porophore-like elevation is found in the supposed setal line where the groove is sharply curved inwardly. Male pore setae only 6. Seminal vesicles a little larger than those of the other varieties. Pseudovesicles, one pair, very small.

9. *Pheretima vittata* (Goto et Hatai) 1898

1938. *Pheretima vittata*, Kobayashi, Sci. Rep. Tôhoku Imp. Univ., Biol., in press.

A Japanese garden in Hakodate, 3 clitellate specimens.

10. *Pheretima yezoensis*, n. sp.

A cultivated field in Hakodate, one clitellate specimen.

Description: External characteristics: Length 190 mm, greatest diameter 7 mm, number of segments 122. Colour in formalin: dorsally dark brown, anteriorly concentrated, and with a light greenish iridescence on postclitellar segments, ventrally dusty grey, clitellum russet. Prostomium, epilobous ca. 2/3. First dorsal pore in 12/13, distinct and functional. Clitellum entire, in XIV-XVI, without setae.

Setae beginning on II, small; those on posterior end slightly enlarged and planted on faintly elevated ridges. Ventral ones a little more closely set than the dorsal, but in intervals no marked difference found between them. Both mid-dorsal and -ventral breaks found but slight. Setal number as follows: 36/III, 54/VI, 63/IX, 19/VII 59/XX, 63/middle portion of the body, spermathecal setae 17/V, 18/VI, 19/VII; male pore setae are almost obliterated, but some setal pits are recognizable under the microscope.

Male pore aspects are characteristic (fig. 4, a). Ventral epidermis of XVIII is moderately raised from the general surface, and appears glandulated and whitish; ventro-laterally on each side a large and circular disc. The disc occupies the whole segment of XVIII, antero-posteriorly and extending farther a little beyond both intersegmental furrows 17/18 and 18/19; the part lateral to it is rounded and whitish and distinct from the neighbourhood; the area between those on both sides is also glandulated, longitudinally wrinkled, and lacks in the setae. On the surface of the disc is found a shallow and longitudinally rectangular depression which appears darkened and is about 2.5 mm in antero-posterior length and about 1/2 as long as wide; within the depression is found a large and transverse slit as a secondary male opening which is somewhat pocket-like in shape.

with its anterior lip inserted intero-posteriorly into a shallow and narrow copulatory chamber. The wall of the copulatory chamber is of a longitudinal musculature, so the surface of the depressed area is different in structure from the part around it, and with fine and longitudinal striations. When the copulatory chamber was pulled out from the inside, it reveals a large and rectangular hole which corresponds to this depression. Pores are ventrally about $1/5$ of the circumference apart.

Female pore single, midventrally on XIV.

Spermathecal pores, three pairs in 5/6-7/8, ventrally about $2/7$ of the circumference apart; each represented as a large and transverse slit in the intersegmental furrow, about three setal wide; within the slit found a minute anterior lip, but to which no special structure is associated internally.

Internal anatomy: Septa well-developed; 5/6, 6/7, 10/11, and 11/12 much thickened and muscled, 7/8, 12/13, and 13/14 moderately thickened, 8/9 ventrally present but thin and shoved backwards into the posterior side of the gizzard, 9/10 absent.

Gizzard large, globular, in 7/8 10/11. Intestine begins to swell in XVI $1/2$ (not distinctly swollen up in this region). Caeca simple, finger-shaped, in XXVII, extending anteriorly into about XXIV, each with a few ventral indentations.

Hearts in IX asymmetrically developed, those in X and XI enclosed within the respective annular testis sac, and those in XII and XIII as usual. Lymph glands moderate in size, lobular, found behind caecal segment caudalwards.

Testis sacs annular in shape in X and XI, moderate in size; the anterior ring much smaller than the posterior. Seminal vesicles, two pairs in XI and XII; the anterior pair rather vestigial and enclosed within the respective testis sac, the posterior pair very small; oval in shape, blackish, vesicular on surface, and with an indistinctly constricted dorsal lobe which is also slightly vesicular and darkened. Pseudovesicles absent.

Prostate gland large, consisting of several lobes, in XVI-XXI; duct long and moderate in thickness, gradually increasing the thickness ectalwards in a very slight degree; but its ectal end which is buried within the muscular wall of the copulatory chamber, is thinner than the rest. Copulatory chamber slightly projecting dorsally into the coelom as a cushion-like elevation; the prostatic duct opens through

the thick muscular wall into a shallow and narrow chamber as a primary pore (fig. 4, b).

Ovaries rather small, in usual position.

Spermathecae large and characteristic in shape (fig. 4, c); those of the three pairs occupying the whole spermathecal region. Diverticulum several times as large and long as the main portion; the ectal about 1/6-1/5 brownish, slender but weakly muscled, and the remaining part thin-walled and moderately dilated, forming a very long, convoluted seminal chamber which contains a large amount of whitish mass; thin wall of the seminal chamber is glassily shining when seen under the microscope by the transmitted light. The main portion is brownish similar to that in the duct portion of the diverticulum; ampulla ovoidal but dorsoventrally flattened and with slight marginal indentations, and on its proximal portions found several papillose swellings on both dorsal and ventral surfaces; duct thick, subequal in length to the ampulla, and not sharply marked off from the latter.

Remarks: The present species is clearly distinguishable from the other hexathecal members of the genus by its characteristic male pore aspects, shape of spermathecae, and by the annular testis sacs.

11. *Allolobophora caliginosa* (Sav.) f. *trapezoides* (Ant. Dug.) 1826

1933. *Allolobophora caliginosa trapezoides*, Chen, Contr. Biol., Lab. Sci. China, IX, Zool. Ser., 5, pp. 216-221.

1935. *Allolobophora caliginosa trapezoides*, Černosvitov, Monogr. tschechosl. Lumb., p. 53.

1937. *Allolobophora caliginosa trapezoides*, Černosvitov, Rec. Ind. Mus., XXXIX, 2, p. 108.

12. *Allolobophora japonica* Michaelsen 1891

1900. *Helodrilus (Allolobophora) japonicus*, Michaelsen, Tierreich, p. 481.

1934. *Allolobophora japonica* f. *typica*, Ôishi. Zool. Mag., Vol. 46, No. 545, p. 133 (in Japanese).

1936. *Allolobophora japonica*, Kaburaki and Misaka, Botany and Zoology in Nikkô (in Japanese).

1936. *Allolobophora japonica*?, Kobayashi, Sci. Rep. Tôhoku Imp. Univ., Biol., XI, 1, p. 183.

Under grass on the road-side in Nanaé-hama-mura, several clitellate specimens. Under fallen leaves near a cultivated field of the Chinese bell-flowers, about 8 km. from Hakodate, several clitellate specimens. A Japanese garden in Hakodate, one clitellate specimen. A cultivated field in Hakodate, several clitellate specimens.

13. *Eisenia foetida* (Savigny) 1826

1935. *Eisenia foetida*, Černosvitov, Monogr. tschechosl. Lumb., p. 34.

14. *Bimastus tenuis* (Eisen) 1874

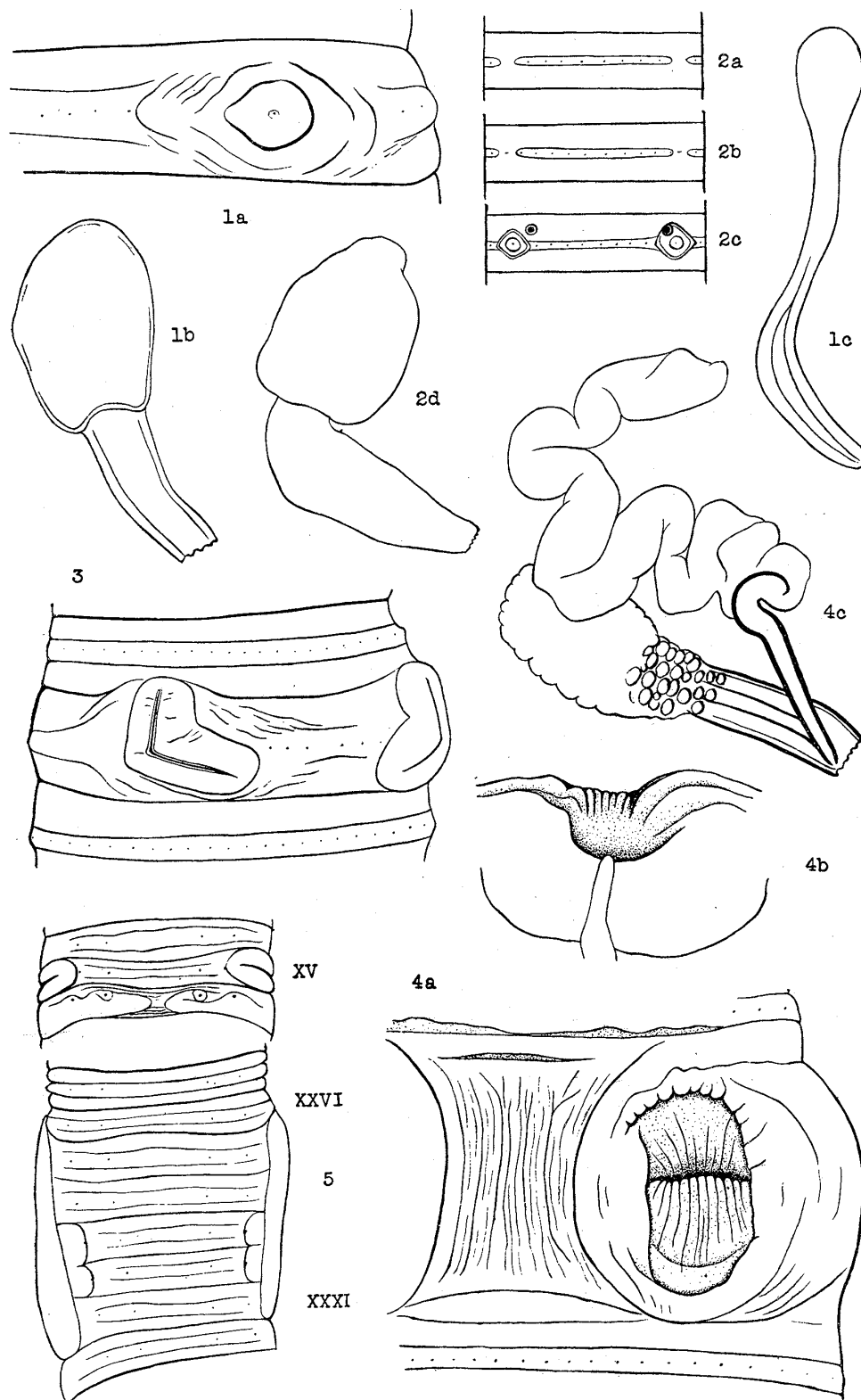
1929. *Bimastus tenuis*, Michaelsen, Ann. Mus. Zool. Acad. Sci. l'URSS. XXX, p. 329.
 1935. *Bimastus tenuis*, Černosvitov, Capita Zool., VI, 1, p. 36.
 1935. *Bimastus tenuis*, Černosvitov, Monogr. tschechosl. Lumb., pp. 63-65, fig. 49.
 1936. *Bimastus tenuis*, Černosvitov, Arch. Zool. Exp. et Gén., Tome 78, No. 1, pp. 3-5, figs. 1-4.
 1936. *Bimastus tenuis*, Černosvitov, Ann. Mag. Nat. Hist., Ser. 10, XVIII, p. 226.
 1937. *Bimastus tenuis*, Černosvitov, Rec. Ind. Mus., XXXIX, 2 p. 110.

A cultivated field in Hakodate, 15 clitellate and 29 a clitellate specimens. Sandy soil overgrown with weeds, about 55 meters from a beach of Nanaé-hama-mura, 7 clitellate and one a clitellate specimens. A cultivated field of the Chinese bell-flowers, 2 clitellate and one a clitellate specimens. Under a heap of horse-manure in Hakodate, a single clitellate specimen.

Description: Length 33-64 mm, greatest diameter 2-3 mm, number of segments 94-105. Colour in formalin, dorsally brownish red with bluish iridescence, postclitellar region lighter than the preclitellar, and the intersegmental furrows whitish, ventrally pale, clitellum grey. Prostomium, epilobous ca. 2/3. First dorsal pore in 5/6. Setae widely paired; setal distance $aa > bc > cd > ab$, or $aa : ab : bc :: cd : dd = 17 : 6.7 : 13 : 7.8 : 50$ on XVII. Setae a and b on XVI are slightly enlarged and planted on a glandulated epidermal elevation. In one specimen, a similar elevation with enlarged setae is found also on XXIV but on right side only. Male pores slit-like, each on a moderate-sized and glandulated elevation which is situated on XV between b and c (fig. 5). Clitellum saddle-shaped, usually in XXVI-XXXI, sometimes in XXVI-XXXII or 1/2 XXVI-XXXI, seldom in 1/2 XXV-XXXI or XXVI-1/2 XXXII or 1/2 XXVI-1/2 XXXII. Tubercula pubertatis are found in all specimens but sometimes poorly developed; usually in XXIX-XXX, sometimes in 1/2 XXIX-XXX or 1/2 XXIX-1/2 XXX; slightly elevated and glandulated, and seta b planted on its medial margin on each side (fig. 5). Spermathecal pores and spermathecae are absent in all specimens. Seminal vesicles, two pairs in XI and XII, moderate in size.

EXPLANATION OF PLATE 22

- Fig. 1. *Ph. Marenzelleri*: a. ventral view of XVIII, b. a normal spermatheca, c. an abnormal spermatheca.
- Fig. 2. *Ph. oyamai*: a—c, schematic ventral view of XVIII, d. a spermatheca.
- Fig. 3. *Ph. phaselus tamurai*, n. var.: ventral view of male pore region.
- Fig. 4. *Ph. yezoensis*, n. sp.: a ventral view of XXIII, b. optical transverse section of terminalia of male organ. c. a spermatheca.
- Fig. 5. *B. tenuis*: ventral view of genital segments.
1a, 3, 4a, b, c, 5 \times ca. 11.5; 1b, c, 2d. \times ca. 26.



S. KOBAYASHI: EARTHWORMS FROM HAKODATE, HOKKAIDÔ,